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10/686,817	10/17/2003	Yoshifumi Arai	Q77855	8793

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EXAMINER	
CHENG, PETER L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/686,817	ARAI, YOSHIFUMI	
	Examiner	Art Unit	
	Peter L. Cheng	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 June 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/17/2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: **Fig. 4** reference character **S110** (or "Step 110")

Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. Applicant is reminded of the proper format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

- the number of words contained in the abstract currently exceeds 200 words; any further modifications to the abstract should attempt to either reduce or at least, not exceed the current length;

3. The disclosure is objected to because of the following informalities:

- **Abstract, page 100, line 3 - 5:** for clarity, suggest replacing "It used to be difficult to carry out color conversion with accuracy in the high-lightness range without the occurrence of tone jump" to "Previously, it was difficult to accurately convert colors in the high-lightness range without the occurrence of a tone jump", or similar wording;

- **Abstract, page 100, line 9 ff**: for clarity, suggest replacing "At this time, correction for interpolation accuracy enhancement is carried out beforehand so that colors in the low-lightness range will be larger in number than colors in

the high-lightness range" with "*Initially*, correction for interpolation accuracy enhancement is carried out so that the *number of colors* in the low-lightness range will be *more* than the number of colors in the high-lightness range", or similar wording;

- **Abstract, page 100, line 12 ff**: for clarity, suggest replacing "This is intended to compensate the resolution which is relatively degraded in the low-lightness range by correction for resolution enhancement by interpolation accuracy" with "Correction for interpolation accuracy compensates the relative degradation in resolution in the low-lightness range which occurs during correction for resolution enhancement", or similar wording;

- There are some typographical and grammatical errors in the disclosure; applicant may choose to implement the following suggestions; for example, **page 2, line 6 (**"a RGB" to "an RGB"**); page 2, line 9 and throughout (**"half tone" to halftone"**); page 3, lines 9, 10 (**"is different between in a high-lightness range and in a low-lightness range" to "differs between a high-lightness range and a low-lightness range"**); page 4, line 11 (**"as well as interpolation" to "as well as from interpolation"**); page 4, line 14 (**"a generating method for color conversion table" to "a method for generating a color conversion table"**); page 4, line 17 (**"in all the" to "in all"**); page 4, line 24 (**"colors determined" to "colors are determined"**); page 8, line 9 (**"all the

lightness ranges" to "all lightness ranges"); **page 8, line 9** ("by color" to "by a color"); **page 8, line 11** ("of value" to "of values"); **page 9, line 11** ("1," to "1",); **page 11, line 1** ("can be highly accurately carried out" to "can be performed with high accuracy"); **page 11, line 11** ("brining" to "bringing"); **page 13 line 3** ("difference" to "differences"); **page 13, line 4** ("range of value" to "range of values"); **page 15, lines 9 - 10** ("cannot be indefinitely considered" to "cannot be ignored", or similar wording); **page 18, line 24** ("of value" to "of values"); **page 19, line 23** ("it turns out that a part on the low lightness side is excluded from the gradation value range" to "part of the low lightness side can be excluded from the gradation value range", or similar wording); **page 21, line 28** ("1," to "1",); **page 28, line 16** ("this workings" to "these workings"); **page 28, line 26** ("it can be said that: this method utilizes ink values different in sense from" to "it can be said that this method utilizes ink values in a different sense from"); **page 29, line 15** ("plurality of actually printed" to "plurality of printed"); **page 31, line 24** ("it is only has" to "it only has"); **page 31, line 28** ("processing wherein a deviation equivalent to the fractional portion obtained as the result of the inverse correction is reflected can be adopted" to "processing *can be adopted* wherein a deviation equivalent to the fractional portion obtained as the result of the inverse correction is reflected"); **page 32, line 15** ("cannot be indefinitely considered" to "cannot be ignored", or similar wording); **page 33, line 5** ("tone jump" to "a tone jump"); **page 34, line 21** ("being implemented" to "being performed" or

"being executed", or similar); **page 34, line 26** ("process of the generating method for color conversion table" to "process of the method for generating a color conversion table"); **page 35, line 1** ("how the pitch of variation in reference point is reduced" to "how the variation in pitch of reference points is reduced"); **page 35, line 19** ("part of high" to "part of the high"); **page 36, line 16** ("Major part" to "The major part"); **page 36, line 22** ("in that printer" to "in the printer"); **page 37, line 7** ("with respect each" to "with respect to each"); **page 37, line 17** ("actually performed with" to "performed by"); **page 39, line 10** ("to be" to "are"); **page 39, line 11** ("any rule to go by" to "following a rule", or similar wording); **page 39, line 21** ("taken on" to "assigned to", or similar); **page 41, line 25** ("it used to be impossible" to "it was previously not possible"); **page 41, line 26** ("without tone jump" to "without a tone jump"); **page 41, line 27** ("quantity is increases" to "quantity increases"); **page 42, line 2** ("it used to be impossible" to "it was previously not possible"); **page 43, line 5** ("value" to "values"); **page 43, line 10** ("recording rate" to "ink recording rate"); **page 44, line 2** ("input value" to "input values"); **page 44, line 3** ("lightness value" to "lightness values"); **page 44, line 4** ("output value" to "output values"); **page 44, line 28** ("taken on" to "assigned to"); **page 45, line 21** ("input values taken on horizontal axis and output values taken on vertical axis" to "input values on the horizontal axis and output values on the vertical axis"); **page 47, line 4** ("and CMYKlclm data is subjected to color separation and further to [gamma] correction" to "and further subjected to color

separation to produce CMYKlclm data which, in turn, is subjected to [gamma] correction"); **page 52, line 2** ("data is" to "data are"); **page 53, line 1** ("frictional" to "fractional"); **page 54, line 9** ("0.0810" to "0.810"); **page 62, line 1** ("210" to "210c"); **page 62, line 2** ("which has" to "which have"); **page 62, line 19** ("LUT" to "LUT 12c"); **page 62, line 23** ("without tone" to "without a tone"); **page 65, line 26** ("subjected color" to "subjected to color"); **page 66, line 8** ("theses" to "these"); **page 68, line 11** ("trebled" to "tripled"); **page 70, line 11** ("value does not" to "value is not"); **page 73, line 24** ("values are taken on horizontal" to "values are assigned to the horizontal"); **page 73, line 25** ("values are taken on vertical axis" to "values are assigned to the vertical axis"); **page 78, line 4** ("210" to "210c"); **page 78, line 5** ("which has" to "which have"); **page 79, line 15** ("3." to "3".);

- **Page 5, line 23:** it is assumed that applicant intended to cite **unit variation in gradation values** instead of **unit variation**;

- **Page 6, lines 2 – 6:** for clarity, applicant may consider changing "At this time, a smaller number of reference values *before correction* than the total number of the levels of predetermined gradation value *before correction* are extracted from the gradation values *before correction* with respect to each ink color. Then, the reference values *before correction* are combined." to "*Before correction*, <u>a smaller number</u> of reference values than the total number of

levels of predetermined gradation value<u>s</u> <u>is</u> extracted from the gradation values with respect to each ink color. Then, the reference values are combined", or similar wording;

- **Page 6, lines 12 ff:** for clarity, it is assumed that applicant intended to cite "Therefore, if it is assumed that the magnitude of values and ink quantity <u>*are*</u> in substantially linear correspondence with respect to the reference values before correction, the *number* of colors are in the following relation: <u>*in a low-lightness range, the number of colors increase*</u> after correction for interpolation accuracy enhancement"

  instead of

  "Therefore, if it is assumed that the magnitude of values and ink quantity <u>*is*</u> in substantially linear correspondence with respect to the reference values before correction, the numbers of colors are in the following relation: <u>*colors indicated by data*</u> after correction for interpolation accuracy enhancement <u>*are larger in number than colors indicated by the individual data sets in a low-lightness range*</u>";

- **Page 7, line 8; page 7, lines 11, 16, 22; page 10, line 6; page 43, line 4; page 48, line 1:** suggest **substantially and** instead of **substantially**;

- **Page 9, line 7; page 11, line 20; page 20, line 13; page 23, line 16; page 25, line 6; page 28, line 3; page 29, lines 24, 26; page 30, lines 2, 19, 24; page 31, line 23; page 33, line 2; page 35, line 10; page 36, line 18, 20; page 37, lines 12, 37; page 41, line 3; page 44, lines 10, 12; page 47, line 10; page 59, lines 1, 5, 24; page 60, line 1; page 62, line 22; page 77, line 19; page 80, line 8:** suggest **a print operation** instead of **print operation**;

- **Page 12, lines 15, 25; page 13, lines 2, 5; page 26, lines 15, 24; page 27, lines 2, 5; page 29, line 1; page 44, line 1; page 67, lines 17, 27; page 68, line 13:** suggest **the range of ink recording rate values** instead of **the range of value of ink recording rate**;

- **Page 13, line 15:** assume **third aspect** refers to claim 3; since neither a "first aspect" nor "second aspect" has been specifically mentioned, suggest "linking" **third aspect** with claim 3; for example, **according to a third aspect, as cited in claim 3, of the present invention ...**;

- **Page 13, lines 25 ff:** for clarity, suggest changing "so that *colors* in the low-lightness range are larger in *number* than *colors* in the high-lightness range" to "so that *there are more colors* in the low-lightness range than in the high-lightness range", or similar wording;

- **Page 16, lines 27 ff:** for clarity, suggest changing "*colors* in the low-lightness range are made larger in *number* than *colors* in the high-lightness range" to "*there are more colors* in the low-lightness range than in the high-lightness range", or similar wording;

- **Page 17, line 14:** for clarity, the horizontal spacing between words should be reviewed and adjusted as necessary; for instance, **predetermined color space constituted** appears as **predeterminedcolorspaceconstituted**; there are other similar instances throughout;

- **Page 18, lines 17 ff:** for clarity, suggest changing "*colors* in the low-lightness range will be larger in *number* than *colors* in the high-lightness range" to "*there are more colors* in the low-lightness range than in the high-lightness range", or similar wording;

- **Page 2, line 1:** suggest changing **equipment-dependent** to **device-dependent;**

- **Page 17, lines 19, 24, 25; page 18, lines 1, 8, 11; page 31, lines 2, 5, 6, 10, 16, 19; page 37, lines 20, 22; page 57, line 17; page 76, line 13:** suggest changing **non-equipment-dependent color space** to **device-independent color space**;

- **Page 20, line 28; page 33, line 16; page 37, line 15; page 38, line 27:** suggest changing **equipment** to **device**;

- **Page 20, lines 22, 23, 25: third aspect**, **eighth aspect**, and **fourth to seventh aspects** appear to be referring to claims 3, 8 and 4 through 7, respectively; if so, suggest re-writing so as to make clear that the "aspects" refer to "claims";

- **Page 22, lines 5, 7:** with respect to **page 9, lines 20 ff**, should "1%" be replaced with "m%"?

- **Page 27, line 6: tenth aspect** appears to be referring to claim10; if so, suggest re-writing so as to make clear that the "aspect" refers to a "claim";

- **Page 33, lines 11, 12, 13, 28: a 13th or 14th aspect**, **a 19th or 20th aspect**, **15th to 18th aspects** and **ninth aspect** appear to be referring to the corresponding claims; if so, suggest re-writing so as to make clear that the "aspects" refer to "claims";

- **Page 34, lines 1, 4, 5: fourth to seventh aspects**, **a 21st or 22nd aspect**, and **15th to 18th aspects** appear to be referring to the corresponding claims; if so, suggest re-writing so as to make clear that the "aspects" refer to "claims";

- **Page 48, line 28:** for clarity, suggest replacing **separation there** with **separation there at Step S110**;

- **Page 51, line 11:** suggest re-writing the phrase, "a smaller value in CMYKlclm data after color separation does not necessarily *more greatly vary* between before and after [gamma] correction";

- **Page 52, lines 20 ff:** the underlined portion of the sentence, "The [gamma] interpretation portion 11d1 is capable of calculating values in the ink value data 12b which has not been subjected to [gamma] correction for resolution enhancement yet" is not clear since it is assumed that from **Fig 5**, all "ink value data after [gamma correction] **12b** has been "gamma corrected for resolution enhancement" (as shown by **11c**);

- **Page 53, line 9:** for clarity, it is assumed that applicant intended to cite "a variation in dot count corresponding to a one step variation in gradation is not 1 but rather a large number of steps in dot variation" instead of "variation in dot count corresponding to variation by one step of gradations is not 1 but

one step-variation in gradation results in a large number of steps in dot variation";

- **Page 63, line 22 ff:** should "gradient of ½" be changed to "gradient of 1" or a "slope of 1"? if so, suggest, changing sentence to "In a graph with input values on the horizontal axis and output values on the vertical axis, a straight line with a slope of 1 which passes through the origin point indicates a state in which correction is not carried out";

- **Page 64, line 25; page 78, line 21:** in regards to the term **coefficient of fluctuation,** further clarification is needed;

- **Page 74, line 7:** suggest re-writing the phrase, "a smaller value in CMYKlclm data after color separation does not necessarily *more greatly vary* between before and after [gamma] correction";

- **Page 75, line 12:** in regards to the underlined portions of the phrase, "subtle variation corresponding to the fractional portions can be represented by nature", further clarification is needed;

Appropriate correction is required.

Claim Objections

4. Claim 1 is objected to because of the following informalities:

- **Page 81, lines 3 - 4 : "the correspondence"** lacks antecedent basis;
- **Page 81, line 4: "the color component values"** lacks antecedent basis;
- **Page 81, line 6: "the ink quantities"** lacks antecedent basis;
- **Page 81, lines 7 - 8: "the result of the color measuring"** lacks antecedent basis;
- **Page 81, line 15: "the presence or absence of ink dots"** lacks antecedent basis;
- **Page 81, lines 10, 23: "the total number of gradations"** lacks antecedent basis;
- **Page 82, line 3: "the ink quantity"** lacks antecedent basis;
- **Page 82, line 9: "the ink recording rate"** lacks antecedent basis;
- **Page 82, lines 9 - 10: "the unit variation"** lacks antecedent basis;
- **Page 82, line 15: "the definition"** lacks antecedent basis;

5. Claim 2 is objected to because of the following informalities:

- **Page 82, line 3: "the total number of gradations"** lacks antecedent basis;

- **Page 82, lines 3 - 4:** it is assumed that applicant intended to cite **range of values of said ink recording rate** instead of **range of value ink recording rate**;

6. Claim 3 is objected to because of the following informalities:

- **Page 82, line 2: "the correspondence"** lacks antecedent basis;
- **Page 82, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 82, line 4: "the color component values"** lacks antecedent basis;
- **Page 83, line 1: "the ink quantity"** lacks antecedent basis;
- **Page 83, line 2: "the magnitude of the gradation values"** lacks antecedent basis;
- **Page 83, line 14:** suggest replacing "to perform print operation" with "to perform a print operation";
- **Page 83, line 17: "the color component values"** lacks antecedent basis;
- **Page 83, lines 23, 25: "the low-lightness range"** lacks antecedent basis;
- **Page 83, line 24: "the high-lightness range"** lacks antecedent basis;
- **Page 83, lines 23 ff:** for clarity, suggest changing "so that *colors* in the low-lightness range will be larger in *number* than *colors* in the high-lightness range" to "so that *there are more colors* in a low-lightness range than in a high-lightness range", or similar wording;

7. Claim 4 is objected to because of the following informalities:

- **Page 84, line 5: "the number of ink colors"** lacks antecedent basis;

8. Claim 5 is objected to because of the following informalities:

- **Page 84, line 4: "the ink quantity"** lacks antecedent basis;
- **Page 84, line 4: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 84, line 8: "the result of the correction"** lacks antecedent basis;

9. Claim 6 is objected to because of the following informalities:

- **Page 84, line 4: "the highest ink recording rate"** lacks antecedent basis;

10. Claim 7 is objected to because of the following informalities:

- **Page 85, line 2: "the correspondence"** lacks antecedent basis;
- **Page 85, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 85, line 4: "the color component values"** lacks antecedent basis;
- **Page 85, lines 7 – 8:** suggest "causes a print operation" instead of "causes print operation";
- **Page 85, line 10: "the color at each pixel"** lacks antecedent basis;
- **Page 85, line 13: "the ink quantity"** lacks antecedent basis;
- **Page 85, line 13: "the magnitude of gradation values"** lacks antecedent basis;

- **Page 85, line 24:** with respect to a "print controller" and **Fig. 8**, "the color converting unit" [**page 85, line 12**] does not appear to "generate a color conversion table" [**page 85, line 24**]; if so, suggest deleting or re-writing "generates a color conversion table where said ink value data ... by said correction for resolution enhancement by interpolation accuracy" [from **page 85, line 24** to **page 86, line 6**];

  <u>*for the purpose of examination, the above-mentioned section from **page 85, line 24** through **page 86, line 6** will not be considered in the claim rejection;*</u>

- **Page 86, lines 2, 5: "the low-lightness range"** lacks antecedent basis;
- **Page 86, line 3: "the high-lightness range"** lacks antecedent basis;
- **Page 86, lines 2 ff:** for clarity, suggest changing "so that *colors* in the low-lightness range will be larger in *number* than *colors* in the high-lightness range" to "so that *there are more colors* in <u>a</u> low-lightness range than in <u>a</u> high-lightness range", or similar wording;
- **Page 86, lines 12, 16: "the recording density"** lacks antecedent basis;

11. Claim 8 is objected to because of the following informalities:

- **Page 86, line 2: "the correspondence"** lacks antecedent basis;
- **Page 86, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 86, line 4: "the color component values"** lacks antecedent basis;

- **Page 87, line 1: "the ink quantity"** lacks antecedent basis;
- **Page 87, line 1: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 87, line 8: "the result of the correction"** lacks antecedent basis;
- **Page 87, line 14:** suggest replacing "perform print operation" with "perform a print operation";
- **Page 87, lines 25, 27: "the low-lightness range"** lacks antecedent basis;
- **Page 87, line 26: "the high-lightness range"** lacks antecedent basis;
- **Page 87, lines 25 ff:** for clarity, suggest changing "so that *colors* in the low-lightness range will be larger in *number* than *colors* in the high-lightness range" to "so that *there are more colors* in a low-lightness range than in a high-lightness range", or similar wording;

12. Claim 9 is objected to because of the following informalities:

- **Page 88, line 3: "the correspondence"** lacks antecedent basis;
- **Page 88, line 4: "the ink quantities"** lacks antecedent basis;
- **Page 88, line 5: "the color component values"** lacks antecedent basis;
- **Page 88, line 10: "the ink quantity"** lacks antecedent basis;
- **Page 88, line 10: "the magnitude of the gradation values"** lacks antecedent basis;
- **Page 88, line 19: "the result of the correction"** lacks antecedent basis;

- **Page 88, line 24:** suggest replacing "performing print operation" with "performing a print operation";
- **Page 89, line 4:** suggest replacing "are correspondence" with "are in correspondence";
- **Page 89, line 5: "the ink result"** lacks antecedent basis;
- **Page 89, lines 8, 10: "the low-lightness range"** lacks antecedent basis;
- **Page 89, line 9: "the high-lightness range"** lacks antecedent basis;
- **Page 89, lines 8 ff:** for clarity, suggest changing "so that *colors* in the low-lightness range will be larger in *number* than *colors* in the high-lightness range" to "so that *there are more colors* in <u>a</u> low-lightness range than in <u>a</u> high-lightness range", or similar wording;

13. Claim 10 is objected to because of the following informalities:

- **Page 89, line 2: "the correspondence"** lacks antecedent basis;
- **Page 89, line 4: "the color component"** lacks antecedent basis;
- **Page 89, line 9:** suggest replacing "value" with "values";
- **Page 89, lines 11 - 12: "the ink recording rate"** lacks antecedent basis;
- **Page 89, line 12: "the unit variation"** lacks antecedent basis;

14. Claim 11 is objected to because of the following informalities:

- **Page 90, line 4: "the correspondence"** lacks antecedent basis;
- **Page 90, line 4: "the color component"** lacks antecedent basis;

- **Page 90, line 6: "the ink quantities"** lacks antecedent basis;
- **Page 90, line 8: "the result of the color measuring"** lacks antecedent basis;
- **Page 90, line 11:** suggest replacing "respected" with "respect";
- **Page 90, line 16: "the presence or absence"** lacks antecedent basis;
- **Page 90, line 24:** suggest replacing "value" with "values";
- **Page 90, line 25: "the ink recording rate"** lacks antecedent basis;
- **Page 91, line 1: "the unit variation"** lacks antecedent basis;
- **Page 91, line 7: "the definition"** lacks antecedent basis;

15. Claim 12 is objected to because of the following informalities:

- **Page 91, line 3: "the total number of gradations"** lacks antecedent basis;

16. Claim 13 is objected to because of the following informalities:

- **Page 91, line 2: "the correspondence"** lacks antecedent basis;
- **Page 91, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 91, line 4: "the color component"** lacks antecedent basis;
- **Page 91, lines 7 - 8: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 91, line 9: "the ink quantity"** lacks antecedent basis;
- **Page 91, line 13: "the resolution"** lacks antecedent basis;
- **Page 91, line 14: "the high-lightness range"** lacks antecedent basis;

- **Page 92, line 1: "the result"** lacks antecedent basis;
- **Page 92, line 1:** suggest replacing "of print operation" with "of a print operation";
- **Page 92, line 5: "the correspondence"** lacks antecedent basis;

17. Claim 14 is objected to because of the following informalities:

- **Page 92, line 2: "the correspondence"** lacks antecedent basis;
- **Page 92, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 92, line 4: "the color component values"** lacks antecedent basis;
- **Page 92, line 7:** suggest replacing "performing print operation" with "performing a print operation";
- **Page 92, line 10: "the ink quantity"** lacks antecedent basis;
- **Page 92, line 10: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 92, line 17: "the color component values"** lacks antecedent basis;
- **Page 92, line 20: "the results of the print operation"** lacks antecedent basis;

18. Claim 16 is objected to because of the following informalities:

- **Page 93, line 4: "the result of the correction"** lacks antecedent basis;

19. Claim 17 is objected to because of the following informalities:

- **Page 93, lines 2, 7: "the lower lightness"** lacks antecedent basis;
- **Page 93, line 4: "the highest ink recording rate"** lacks antecedent basis;

20. Claim 18 is objected to because of the following informalities:

- **Page 94, line 1: "the correspondence"** lacks antecedent basis;
- **Page 94, line 2: "the ink quantities"** lacks antecedent basis;
- **Page 94, line 3: "the color component values"** lacks antecedent basis;
- **Page 94, line 7:** suggest replacing "causes print operation" to "causes a print operation";
- **Page 94, line 12:** suggest replacing "performs print operation" to "performs a print operation";
- **Page 94, line 15: "the ink quantity"** lacks antecedent basis;
- **Page 94, line 16: "the magnitude of gradation"** lacks antecedent basis;
- **Page 94, line 21: "the color component values"** lacks antecedent basis;
- **Page 94, line 23 - 24: "the result"** lacks antecedent basis;
- **Page 94, line 28: "the ink quantities"** lacks antecedent basis;
- **Page 95, lines 1, 5: "the recording density"** lacks antecedent basis;

21. Claim 19 is objected to because of the following informalities:

- **Page 95, lines 2 - 3: "the correspondence"** lacks antecedent basis;
- **Page 95, line 3: "the ink quantities"** lacks antecedent basis;
- **Page 95, line 5: "the color component values"** lacks antecedent basis;

- **Page 95, line 9: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 95, line 9: "the ink quantity"** lacks antecedent basis;
- **Page 95, line 14: "the relative resolution"** lacks antecedent basis;
- **Page 95, line 14: "the high-lightness range"** lacks antecedent basis;
- **Page 95, line 18:** suggest replacing "performs print operation" with "performs a print operation";
- **Page 96, lines 3 - 4: "the correspondence"** lacks antecedent basis;
- **Page 96, line 4: "the color component values"** lacks antecedent basis;

22. Claim 20 is objected to because of the following informalities:

- **Page 96, lines 2 - 3: "the correspondence"** lacks antecedent basis;
- **Page 96, line 3 - 4: "the ink quantities"** lacks antecedent basis;
- **Page 96, line 5: "the color component values"** lacks antecedent basis;
- **Page 96, line 10: "the ink quantity"** lacks antecedent basis;
- **Page 96, line 10: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 96, line 15:** suggest replacing "performs print operation" with "performs a print operation";
- **Page 96, line 17 - 18: "the result of the print operation"** lacks antecedent basis;

23. Claim 21 is objected to because of the following informalities:

- **Page 97, line 1:** as with claim 22, assume applicant intended to cite **A medium with a correspondence definition data *creating program* recorded thereon ...** instead of **A medium with a correspondence definition data recorded thereon ...;**
- **Page 97, line 3: "the correspondence"** lacks antecedent basis;
- **Page 97, line 4: "the ink quantities"** lacks antecedent basis;
- **Page 97, line 5: "the color component values"** lacks antecedent basis;
- **Page 97, line 10: "the magnitude of gradation"** lacks antecedent basis;
- **Page 97, line 10: "the ink quantity"** lacks antecedent basis;
- **Page 97, line 15: "the relative resolution"** lacks antecedent basis;
- **Page 97, line 15: "the high-lightness range"** lacks antecedent basis;
- **Page 97, line 19:** suggest replacing "performing print operation" with "performing a print operation";
- **Page 97, lines 20 - 21: "the result"** lacks antecedent basis;
- **Page 97, lines 23 - 24: "the correspondence"** lacks antecedent basis;
- **Page 97, line 24: "the color component values"** lacks antecedent basis;
- **Page 98, line 2: "the result"** lacks antecedent basis;

24. Claim 22 is objected to because of the following informalities:

- **Page 98, line 3: "the correspondence"** lacks antecedent basis;
- **Page 98, line 4: "the ink quantities"** lacks antecedent basis;

- **Page 98, line 5: "the color components"** lacks antecedent basis;
- **Page 98, line 11: "the ink quantity"** lacks antecedent basis;
- **Page 98, lines 11 - 12: "the magnitude of gradation values"** lacks antecedent basis;
- **Page 98, line 17:** suggest replacing "performing print operation" with "performing a print operation";
- **Page 98, line 20: "the result"** lacks antecedent basis;

Appropriate correction is required.

Claim Rejections - 35 USC § 101

25. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

26. Claims 9, 21 and 22 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claims 9, 21 and 22 are drawn to functional descriptive material NOT claimed as residing on a computer readable medium. MPEP 2106.IV.B.1(a) (Functional Descriptive Material) states:

> "Data structures not claimed as embodied in a computer-readable medium are descriptive material per se and are not statutory because they are not capable of causing functional change in the computer."

> "Such claimed data structures do not define any structural or functional interrelationships between the data structure and other claimed aspects of the invention which permit the data structure's functionality to be realized."
>
> "In contrast, a claimed computer-readable medium encoded with the data structure defines structural and functional interrelationships between the data structure and the computer software and hardware components which permit the data structure's functionality to be realized, and is thus statutory."

Claims 9, 21 and 22, while respectively defining **A medium with a color conversion table generating program recorded thereon ..., A medium with a correspondence definition data** ***creating program*** **recorded thereon ...,** and **A medium with a correspondence definition data creating program recorded thereon ...**, do not define a "computer-readable medium" and are, therefore, non-statutory for that reason. In addition, a **program** can range from paper on which the program is written, to a program simply contemplated and memorized by a person. The examiner suggests amending so as to respectively cite, **A** ***computer-readable*** **medium with a** ***computer-executable*** **color conversion table-generating program recorded thereon ..., A** ***computer-readable*** **medium with a** ***computer-executable*** **correspondence definition data-*****creating program*** **recorded thereon ...,** and **A** ***computer-readable*** **medium with a** ***computer-executable*** **correspondence definition data-creating program recorded thereon ...**, in order to make the claim statutory.

Claim Rejections - 35 USC § 103

27. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

28. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

29. Claims 1 - 2, 3 - 6, 8, 9, 10, 11 - 12, 13, 14 – 17, 19, 20, 21, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over **JACOBS [US Patent 5,481,655]** in view of **MAHY [6,575,095 B1]**.

As for claim 1, JACOBS teaches a <u>color conversion table generating method</u> wherein a plurality of patches outputted from a printing device **[Fig. 2** color patches **32]** are subjected to color measuring **[Fig. 2** spectrophotometer **36]** and a color conversion table **[Fig. 6** custom ink table **74]** which defines the correspondence between the color component values of various colors used in another image device **[Fig. 6** monitor model **22]** and <u>ink value data</u> corresponding to the ink quantities of inks in individual ink colors

used in the printing device **[Fig. 6** master ink table **70]** is generated based, on the result of the color measuring, the method comprising:

a step for extracting a smaller number of reference values than the total number of gradations in said <u>ink value data</u> with respect to each ink color and combining them thereby to create patch data which specifies a plurality of said patches

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

~~a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches~~;

and a step for generating said color conversion table based on color measuring data obtained by subjecting a plurality of the printed patches to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51],**

wherein the colors in said patch data are colors obtained by extracting a smaller number of reference values *before correction* than the total number of gradations in predetermined gradation values *before correction* from the gradation values *before correction* with respect to each ink color and combining the reference values *before correction*

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32. As is known in the art, the ink values typically have the intensity values of grid points 33 (FIG. 3A) on a three-dimensional grid 34 and there is one ink value for each grid point 33"; **col. 5, lines 33 - 39],**

~~**carrying out correction for interpolation accuracy enhancement to increase the reference values *before correction*, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other;**~~

~~**wherein said ink value data is defined so that a *gradation value* which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range *will be reduced in the ink recording rate* corresponding to the unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range;**~~

~~and wherein in said halftone processing, ink quantities corresponding to the reference values in said patch data are interpreted according to the definition of the gradation values to generate said halftone image data.~~

However, JACOBS does not teach

a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches;

carrying out correction for interpolation accuracy enhancement to increase the reference values *before correction*, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other;

wherein said ink value data is defined so that a *gradation value* which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range *will be reduced in the ink recording rate* corresponding to the unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range;

and wherein in said halftone processing, ink quantities corresponding

to the reference values in said patch data are interpreted according to the definition of the gradation values to generate said halftone image data.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches

[Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

carrying out correction for interpolation accuracy enhancement to increase the reference values *before correction*, and thereby bringing the magnitude

of values after the correction and the ink quantity into substantially linear correspondence with each other

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**;

wherein said <u>ink value data</u> is defined so that a *gradation value* which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range *will be reduced in the ink recording rate* corresponding to the unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and

into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and wherein in said halftone processing, ink quantities corresponding to the reference values in said patch data are <u>interpreted</u> according to the definition of the gradation values to generate said halftone image data [From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors

between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 2, MAHY further teaches the color conversion table generating method according to Claim 1, wherein

> **said ink value data is defined by allocating the total number of gradations to part of the range of value of ink recording rate**
>
> [With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30.** In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 3, JACOBS teaches a color conversion table generating method for generating a color conversion table which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

> ~~**a step for extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear**~~

~~**correspondence with each other with respect to each ink color and combining them to create first gradation value data;**~~

~~**a step for subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data;**~~

~~**a step for performing halftone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation;**~~

and a step for generating a color conversion table where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data [using a spectrophotometer **36** as shown in **Fig. 2] obtained by subjecting the result of the print operation to color measuring [Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each other**]**;

~~**wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.**~~

However, JACOBS does not teach

a step for extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining them to create first gradation value data;

a step for subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data;

a step for performing halftone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation;

wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a step for extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining them to create first gradation value data

[**Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

a step for subjecting the first gradation value data to <u>correction for resolution enhancement</u> with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69]**;

a step for performing halftone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**]**;

wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 4, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

the gradation values in said <u>first gradation value data</u> are created based on data obtained by transforming coordinates in a predetermined color space

constituted of a smaller number of color components than the number of ink colors into gradation values which indicate the quantities of individual color inks by a predetermined transformation expression

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** The "predetermined transformation expression" corresponds to the "mixing table"**].**

As for claim 5, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

the gradation values in said <u>first gradation value data</u> are obtained by subjecting gradation values where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other to [gamma] correction where a smaller gradation value is corrected with a higher rate of increase as compared with larger gradation values and the result of the correction is outputted

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

To account for dot gain, MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). In this example, MAHY illustrates that smaller gradation values are corrected with a higher rate of increase as compared to larger gradation values; for example, when c_K (in table column 3) is 10%, the output of the LUT (in table column 5) is 20%; this corresponds to a doubling (or increase of 100%) in tone value; however, when the colorant value cK is 80%, the output of the LUT is %74; this difference corresponds to just a 7.5% change**].**

As for claim 6, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

a gradation value which indicates the lowest lightness in said <u>first gradation value data</u> is equivalent to the highest ink recording rate at which the ink can be recorded on a printing medium

[This gradation value corresponds to point **A%** in **Fig. 8];**

and in said <u>correction for resolution enhancement</u>, a predetermined gradation value range containing the gradation value which indicates the lowest lightness is excluded and the correction is carried out so that the remaining gradation value range will be matched with the whole gradation value range of said ink value data

[With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 8, JACOBS teaches a color conversion table generator which generates a color conversion table which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6**

master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the generator comprise:

> **~~a first gradation value data acquiring unit for acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;~~**
>
> **~~an ink value data acquiring unit for subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to acquire the result of the correction as said ink value data;~~**
>
> **~~a print operation performing unit for performing halftone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation;~~**
>
> **a print result color measuring unit for subjecting the result of the print operation to color measuring**

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a color conversion table generating unit for generating a color conversion table where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data obtained by subjecting the result of the print operation to color measuring
[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**],**

~~wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.~~

However, JACOBS does not teach

a first gradation value data acquiring unit for acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;

an ink value data acquiring unit for subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to acquire the result of the correction as said ink value data;

a print operation performing unit for performing halftone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation;

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **a first gradation value data acquiring unit for acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values**
>
> **[Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);
>
> "first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

an ink value data acquiring unit for subjecting the <u>first gradation value data</u> to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to acquire the result of the correction as said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

a print operation performing unit for performing halftone processing, taking into account deviations equivalent to fractional portions obtained

when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 9, JACOBS teaches a medium with a color conversion table generating program recorded thereon for generating a color conversion table which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, wherein the program causes a computer to carry out:

> **~~a first gradation value data acquiring function of acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;~~**
>
> **~~an ink value data acquiring function of subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher lightness~~**

~~**range than to gradation values corresponding to a lower-lightness range and acquiring the result of the correction as said ink value data;**~~

~~**a print operation performing function of performing half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement, and performing print operation;**~~

a print result color measuring function of subjecting the result of the print operation to color measuring
["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a color conversion table generating function of generating a color conversion table where said ink value data and the color component values of various colors used in said another image device are correspondence with each other based on color measuring data obtained by subjecting the result of the print operation to color measuring
[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each other**]**;

~~**wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.**~~

However, JACOBS does not teach

a first gradation value data acquiring function of acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;

an ink value data acquiring function of subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range and acquiring the result of the correction as said ink value data;

a print operation performing function of performing half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement, and performing print operation;

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a first gradation value data acquiring function of acquiring first gradation value data obtained by extracting gradation values where the ink quantity and the magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

an ink value data acquiring function of subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range and acquiring the result of the correction as said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark

cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

a print operation performing function of performing half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement, and performing print operation [From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 10, JACOBS teaches a correspondence definition data **[**i.e., a color conversion table**]** creating method for creating correspondence definition data **[Fig. 6** custom ink table **74]** which defines the correspondence between ink color-by-ink color input gradation values **[Fig. 6** master ink table **70]** ~~to be inputted to a halftone~~

~~processing module~~ and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

a step for creating said correspondence definition data by taking integral values existing in a predetermined range of value as said input gradation values

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

~~**defining the input gradation values so that an input gradation value corresponding to a higher-lightness range will be reduced in variation in the ink recording rate corresponding to the unit variation in that input gradation value as compared with input gradation values corresponding to a lower-lightness range;**~~

and bringing colors indicated by combinations of input gradation values and colors indicated by combinations of said color component values into correspondence with each other with respect to each ink color

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color

component values (i.e., the monitor model **22**) into correspondence with each other**]**.

However, JACOBS does not teach an

input gradation values to be inputted to a halftone processing module

nor

defining the input gradation values so that an input gradation value corresponding to a higher-lightness range will be reduced in variation in the ink recording rate corresponding to the unit variation in that input gradation value as compared with input gradation values corresponding to a lower-lightness range;

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

input gradation values to be inputted to a halftone processing module **[Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**]**

defining the input gradation values so that an input gradation value corresponding to a higher-lightness range will be reduced in variation in the ink recording rate corresponding to the unit variation in that input gradation value as compared with input gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 11, JACOBS teaches a <u>correspondence definition data</u> **[**i.e., a color conversion table**]** creating method wherein plurality of patches outputted from a printing device **[Fig. 2** color patches **32]** are subjected to color measuring **[Fig. 2** spectrophotometer **36]**, and correspondence definition data **[Fig. 6** custom ink table **74]** which defines the correspondence between the color component values of various colors used in another image device **[Fig. 6** monitor model **22]** and gradation values corresponding to the ink quantities of inks in individual colors used in the printing device **[Fig. 6** master ink table **70]** is created based on the result of the color measuring, the method comprising:

a step for extracting a smaller number of reference values than the total number of gradations in gradation values corresponding to said ink

quantities with respected to each ink color and combining them thereby to create patch data which specifies a plurality of said patches

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

~~**a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches**~~**;**

and a step for creating said correspondence definition data based on color measuring data obtained by subjecting a plurality of the printed patches to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51],**

~~**wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in the ink recording rate corresponding to the unit variation**~~

~~in that gradation value as compared with gradation values corresponding to a lower-lightness range;~~

~~and wherein in said halftone processing, ink quantities corresponding to reference values in said patch data are interpreted according to the definition of the gradation values to generate said half tone image data.~~

However, JACOBS does not teach

a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches;

wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in the ink recording rate corresponding to the unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range;

and wherein in said halftone processing, ink quantities corresponding to reference values in said patch data are interpreted according to the definition of the gradation values to generate said half tone image data.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **a step for performing halftone processing where the patch data is inputted and transformed into halftone image data which indicates the presence or absence of ink dots to print a plurality of said patches**
>
> **[Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**
>
> From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**
>
> **wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in the ink recording rate corresponding to the unit variation**

in that gradation value as compared with gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and wherein in said halftone processing, ink quantities corresponding to reference values in said patch data are interpreted according to the definition of the gradation values to generate said half tone image data

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in

turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**]**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 12, MAHY further teaches the correspondence definition data creating method according to Claim 11, wherein

said gradation values corresponding to ink quantities are defined by allocating the total number of gradations to part of the range of value of ink recording rate

[With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47]**.

As for claim 13, JACOBS teaches a correspondence definition data creating method for creating correspondence definition data **[**i.e., a color conversion table**]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

~~**a step for converting colors rendered by combinations of CMY colors to acquire first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;**~~

~~**a step for subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the resolution in the high-lightness range is relatively enhanced;**~~

a step for subjecting the result of print operation performed with said printing device based on the ink value data to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51]**;

and a step for creating correspondence definition data which defines the correspondence between said ink value data and the color component values of various colors used in said another image device from the result of the color measuring

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach

a step for converting colors rendered by combinations of CMY colors to acquire first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;

a step for subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the resolution in the high-lightness range is relatively enhanced;

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **a step for converting colors rendered by combinations of CMY colors to acquire first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other**
>
> **[Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);
>
> "first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**;
>
> **a step for subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create**

ink value data where the resolution in the high-lightness range is relatively enhanced

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the

concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 14, JACOBS teaches a correspondence definition data creating method for creating correspondence definition data **[**i.e., a color conversion table**]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

a step for performing print operation with a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36],**

~~**obtained by subjecting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other to correction with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;**~~

and a step for creating correspondence definition data where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data [using a spectrophotometer **36** as shown in **Fig. 2] obtained by subjecting the result of the print operation to color measuring [Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach ink value data

obtained by subjecting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other to correction with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone

data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates ink value data

> **obtained by subjecting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other to correction with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range**
>
> **[**For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 15, MAHY further teaches the correspondence definition data creating method according to Claim 14, wherein

said ink value data is data obtained by correcting said first gradation value data which indicates color components in a predetermined first color space by a predetermined transformation expression

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8**. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a

larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and when said print operation is performed, halftone processing is performed, taking into account deviations equivalent to fractional portions obtained when correction inverse to the above correction is carried out [From **Fig. 5**, MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data].

As for claim 16, MAHY further teaches the correspondence definition data creating method according to Claim 14, wherein

said correction is [gamma] correction where a smaller input value is corrected with a higher rate of change and the result of the correction is outputted

[With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further

illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69].**

As for claim 17, MAHY further teaches the correspondence definition data creating method according to Claim14, wherein

a gradation value which indicates the lowest lightness in said first gradation value data is equivalent to the highest ink recording rate at which the ink can be recorded on a printing medium

[This gradation value corresponds to point **A%** in **Fig. 8];**

and in said correction, a predetermined gradation value range containing the gradation value which indicates the lowest lightness is excluded and the correction is carried out so that the remaining gradation value range will be matched with the whole gradation value range of said ink value data

[With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average

spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 19, JACOBS teaches a correspondence definition data creating apparatus for creating correspondence definition data **[**i.e., a color conversion table**]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual color used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the apparatus comprising:

~~a color separation unit which transforms colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;~~

~~an ink value data creating unit which subjects the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced;~~

a print operation performing unit which creates print data which specifies ink quantities according to the ink value data and performs print operation with said printing device

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

a print result color measuring unit which subjects the result of the print operation to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a correspondence definition data creating unit which creates correspondence definition data which defines the correspondence between said ink value data and the color component values of various colors used in said another image device from the result of the color measuring

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach

a color separation unit which transforms colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;

an ink value data creating unit which subjects the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced;

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a color separation unit which transforms colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for

black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

an ink value data creating unit which subjects the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 20, JACOBS teaches a correspondence definition data creating apparatus for creating correspondence definition data which **[**i.e., a color conversion table**]** defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the comprising:

~~**an ink value data acquiring unit which acquires a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting first gradation value data where the ink quantity and**~~

~~**the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range**~~

a print operation performing unit which performs print operation with ink quantities specified by the ink value data

[“The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32”; **col. 5, lines 33 - 36];**

a color measuring data acquiring unit which subjects the result of the print operation to color measuring to acquire color measuring data

[“a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32”; **col. 5, lines 47 - 51]**;

and a correspondence definition data creating unit which brings said ink value data and the color component values of various colors used in said another image device into correspondence with each other based on the color measuring data to create correspondence definition data

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach

an ink value data acquiring unit which acquires a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting <u>first gradation value data</u> where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

an ink value data acquiring unit which acquires a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting <u>first gradation value data</u> where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 21, JACOBS teaches a medium with a correspondence definition data *creating program* recorded thereon for creating correspondence definition data **[**i.e., a color conversion table**]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the program causes a computer to carry out:

~~a color separation function of transforming colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;~~

~~an ink value data creating function of subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a~~

~~**smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced;**~~

a print operation performing function of creating print data which specifies ink quantities according to the ink value data and performing print operation with said printing device

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

a print result color measuring function of subjecting the result of the print operation to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a correspondence definition data creating function of creating correspondence definition data which defines the correspondence between said ink value data and the color component values of various colors used in said another image device from the result of the color measuring

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink

table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach

> **a color separation function of transforming colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other;**
>
> **an ink value data creating function of subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced;**

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a color separation function of transforming colors rendered by combinations of CMY colors into first gradation value data where the magnitude of gradation values and the ink quantity are in substantially linear correspondence with each other

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

an ink value data creating function of subjecting the first gradation value data to [gamma] correction with a higher rate of increase applied to a smaller gradation value to create ink value data where the relative resolution in the high-lightness range is enhanced

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 22, JACOBS teaches a medium with a correspondence definition data creating program recorded thereon for creating correspondence definition data **[**i.e., a color conversion table**]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6**

master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the program causes a computer to carry out:

> **~~an ink value data acquiring function of acquiring a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;~~**
>
> **a print operation performing function of performing print operation with ink quantities specified by the ink value data**
> **[**"The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**
>
> **a color measuring data acquiring function of subjecting the result of the print operation to color measuring to acquire color measuring data**
> **[**"a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a correspondence definition data creating function of bringing said ink value data and the color component values of various colors used in said another image device in correspondence with each other based on the color measuring data to create correspondence definition data

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**].**

However, JACOBS does not teach

an ink value data acquiring function of acquiring a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened")

CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **an ink value data acquiring function of acquiring a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range**
>
> [For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further

calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

30. Claims 7, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over **JACOBS [US Patent 5,481,655]** in view of **MAHY [6,575,095 B1]** and well-known prior art.

As for claim 7, JACOBS teaches a print controller which refers to a color conversion table **[Fig. 6** custom ink table **74]** which defines the correspondence between ink value data which specifies the ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in an other image device **[Fig. 6** monitor model **22]**, and creates print data which indicates output images on the printing device from image data which indicates display

images on the image device and causes print operation to be performed, the controller comprises:

an image data acquiring unit for acquiring image data where the color at each pixel in a matrix pattern is rendered with gradations with respect to images on said another image device

[Fig. 1 "image in monitor color space" **10** acquires the image data which is displayed on a monitor; "Image 10 is typically provided from the user in a first coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines 41 - 43];**

a color converting unit which extracts gradation values

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**]**

~~**where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combines the gradation values to create first gradation value data,**~~

~~**subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data,**~~

~~**subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction inverse to said correction for resolution enhancement is carried out, and performs print operation,**~~

As noted earlier in the claim objections, the following limitations regarding the generation of a color conversion table will not be considered;

~~generates a color conversion table where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data obtained by subjecting the result of the print operation to color measuring,~~

~~said first gradation value data being extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy,~~

and refers to the thus generated color conversion table to color-convert said image data into corresponding ink value data

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 - 21];**

~~a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium;~~

~~a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel;~~

~~and a print data outputting unit for outputting the print data to the printing device.~~

However, JACOBS does not teach

where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each

ink color and combines the gradation values to create first gradation value data,

subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data,

subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction inverse to said correction for resolution enhancement is carried out, and performs print operation,

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel;

and a print data outputting unit for outputting the print data to the printing device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates a process for creating calibration tables

where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combines the gradation values to create first gradation value data

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**],**

subjects the first gradation value data to <u>correction for resolution enhancement</u> with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range to obtain said ink value data [For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69],**

subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction

inverse to said correction for resolution enhancement is carried out, and performs print operation

[Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**],**

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium

[Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

However, MAHY does not specifically teach

> **a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel;**
>
> **and a print data outputting unit for outputting the print data to the printing device.**

Official notice is taken that the concepts of a "print data creating unit" and "print data outputting unit" would have been expected in the art.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY in order to implement a print controller which utilized a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation which can be used by a print controller or a software print driver.

As for claim 18, JACOBS teaches a print controller which refers to a correspondence definition data [i.e., a color conversion table; **Fig. 6** custom ink table **74]** which defines the correspondence between ink value data which specifies the ink quantities of inks in

individual colors used in a printing device **[Fig. 6** master ink table **70]** and the color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, and creates print data which indicates output images on the printing device from image data which indicates display images on the image device and causes print operation to be performed, the controller comprising:

an image data acquiring unit for acquiring image data where the color at each pixel in a matrix pattern is rendered with gradations with respect to images on said another image device

[Fig. 1 "image in monitor color space" **10** acquires the image data which is displayed on a monitor; "Image 10 is typically provided from the user in a first coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines 41 - 43];**

a color converting unit which performs print operation with a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**],**

~~**obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;**~~

refers to correspondence definition data where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**],**

based on color measuring data obtained by subjecting the result of the print operation to color measuring and color-converts said image data into corresponding ink value data;

["a spectrophotometer 36 … is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

~~a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the ink quantities into pseudo half tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium;~~

~~a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data;~~

~~and a print data outputting unit which outputs the print data to the printing device.~~

However, JACOBS does not teach

obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range;

a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the

ink quantities into pseudo half tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data;

and a print data outputting unit which outputs the print data to the printing device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates a process for creating calibration tables

obtained by correcting first gradation value data where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a higher-lightness range than to gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the ink quantities into pseudo half tone data where gradations are represented by the recording density of ink droplets recorded on a printing medium [Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

However, MAHY does not specifically teach

a <u>print data creating unit</u> which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data;

and a <u>print data outputting unit</u> which outputs the print data to the printing device.

Official notice is taken that the concepts of a "print data creating unit" and "print data outputting unit" would have been expected in the art.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY in order to implement a print controller which utilized *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when

performing a print operation which can be used by a print controller or a software print driver.

Conclusion

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- U.S. Patent 6,575,095 B1 [JACOBS et al.]
- U.S. Patent 5,818,604 A [DELABASTITA et al.]
- U.S. Patent 7,050,196 B1 [PIATT et al.]
- U.S. Patent 2002/0024687 [ALLEN et al.]
- U.S. Patent 2003/0002058 A1 [COUWENHOVEN et al.]
- U.S. Patent 2003/0063299 A1 [COWAN et al.]

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter L. Cheng whose telephone number is 571-270-3007. The examiner can normally be reached on MONDAY - FRIDAY, 8:30 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, King Y. Poon can be reached on 571-272-7440. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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